physicsUK

Smarter practice. Stronger understanding

WORKSHEETS

ATTEMPT | CHECK | CORRECT | IMPROVE

# AQA AS Kinematics, Projectile Motion and Terminal Speed worksheet

*35–40 minutes independent practice + 15–20 minutes review | 42 marks*

## Specification points covered

| | |
|---|---|
| • 3.4.1.3(a–c) Displacement, speed, velocity and acceleration.<br>• 3.4.1.3(d–f) Motion graphs, gradients and areas.<br>• 3.4.1.3(g–h) Uniform acceleration and straight-line motion. | • 3.4.1.4(a–d) Independent horizontal and vertical projectile motion.<br>• 3.4.1.4(e–h) Drag, non-uniform acceleration and terminal speed.<br>• 8.2.RP3 Determination of g by a free-fall method. |

**Volcanic monitoring flight**

An autonomous drone maps a volcanic valley, drops a sensor and samples dense gas above a vent.
Describe quantities precisely, extract motion from graphs and separate horizontal from vertical projectile motion.

## 1. Survey-line motion

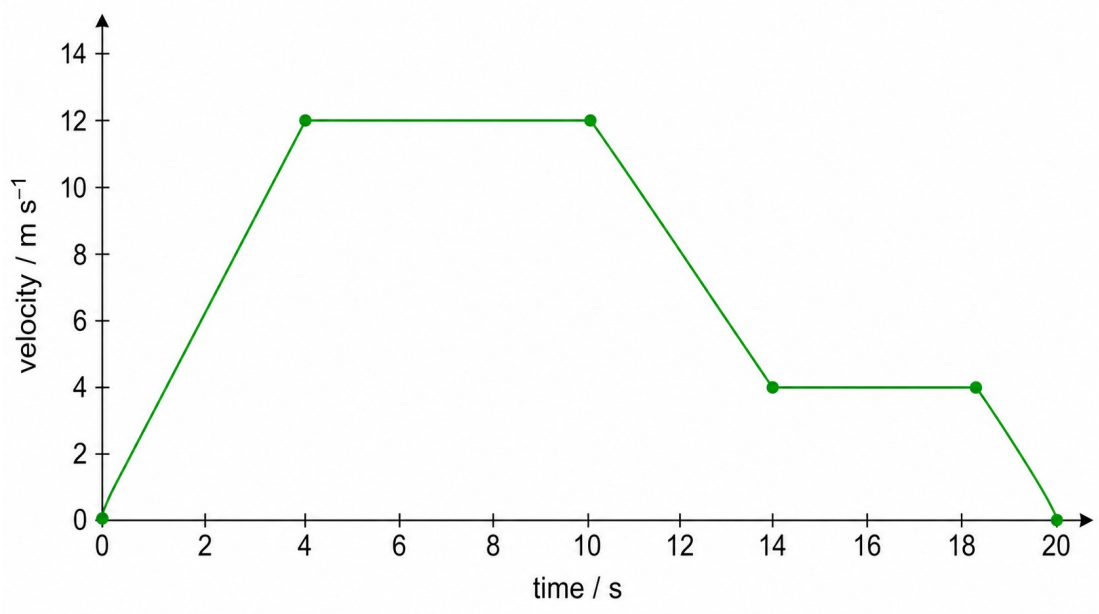
**1. Define displacement, velocity and acceleration. Each definition must identify whether the quantity is a vector and what changes with time. [3 marks]**

**2. A monitoring drone flies 600 m east in 50 s and then 200 m west in 20 s. Calculate its total distance, displacement, average speed and average velocity. [4 marks]**

**3. The drone increases its velocity uniformly from 0 to 18.0 m $s^{-1}$ in 6.00 s. Calculate its acceleration and displacement during this interval. [3 marks]**

## 2. Reading the flight graph

**4. The velocity–time graph shows the drone's motion along a straight survey line. Describe the motion during each of the five straight-line sections. Use the words velocity and acceleration precisely. [3 marks]**




**5. Use the graph to calculate the total distance travelled from 0 to 20 s. [3 marks]**

**6. Use the graph to calculate the displacement between 8.0 s and 16.0 s. [2 marks]**

## 3. Releasing the sensor

**7. The drone releases a sensor horizontally at 18.0 m $s^{-1}$ from a height of 45.0 m. Ignore air resistance. Calculate the time to reach the ground and the horizontal distance travelled. [4 marks]**

**8. For the release in Question 7, calculate the vertical component and the magnitude and direction of the sensor's velocity immediately before impact. [3 marks]**

**9. Air resistance is now significant. Explain how it changes the horizontal velocity, the vertical acceleration while the sensor is falling, and the shape or range of the trajectory. Do not assume the acceleration remains equal to g. [3 marks]**

## 4. Falling through volcanic gas

**10. A sampling capsule falls through dense volcanic gas and reaches terminal speed. Describe how its velocity, acceleration, weight and drag change from release until terminal speed is reached. Use increase, decrease or remain constant for each quantity. [4 marks]**

**11. The capsule has mass 2.40 kg. Calculate the upward drag force when it moves at terminal speed. [1 mark]**

**12. Capsules X, Y and Z have the same shape and move through the same gas. X has mass 2.40 kg and area 0.050 m². Y has mass 4.80 kg and area 0.050 m². Z has mass 2.40 kg and area 0.100 m². Predict the order of their terminal speeds from greatest to smallest and explain your reasoning. [3 marks]**

## 5. Measuring gravitational acceleration

**13. Design a high-speed-camera experiment to determine g from the free fall of a small target. Include a scale, frame rate or timing method, measurements, a graph or calculation, repeats, uncertainty reduction and safety. Explain how the analysis identifies a constant acceleration rather than merely a high speed. [6 marks]**

**Review and improve**

□ I describe what a quantity does, rather than saying that it ‘accelerates’.
□ I use gradient and area with their physical units.
□ I separate projectile components and then recombine the velocity.